REMARKS

This is in response to the Office Action mailed on August 9, 2004. In the Office Action, pending claims 1-20 were rejected under as being anticipated by the prior art. This Amendment cancels method claims 18-20 in favor of apparatus claims, adds new claims 21-24, and amends FIG. 4 to correct minor errors. In reliance on the following remarks, Applicant believes the present application containing claims 1-17 and 21-24 is in condition for allowance, and respectfully requests reconsideration and notice to that effect.

Claims 1-20

In the Office Action, claims 1-20 were rejected under 35 U.S.C. § 102(a) as being anticipated by Sakai et al., U.S. Patent No. 6,674,258 ("Sakai"), and 35 U.S.C. § 102(e) as being anticipated by Inao et al., U.S. Patent Application Publication No. 2004/0000884 ("Inao").

Independent claim 1 and its dependent claims 2-8 each recite a motor controller having a commutation control connected to the motor terminals for causing current pulses to flow through selected terminals during each commutation state and a reverse current control for preventing reverse current from flowing into the power supply during a change of commutation state.

Similarly, each of independent claim 9 and its dependent claims 10-17 recites a motor controller having a plurality of motor drivers connected to the plurality of terminals, sequencer logic, and a pulse width control. The sequencer logic provides control signals to the motor drivers to cause current pulses to flow through selected terminals during each commutation state. The sequencer logic further provides a reset signal for preventing reverse current from flowing into the power supply during a change of commutation state. The pulse width control controls the pulse width of the current pulses as a function of a sense signal, a target signal, and the reset signal.

None of the prior art of record teaches this claimed reverse current control. Sakai and Inao are primarily concerned with preventing a sharp change in current through a particular phase of an electric motor, such as those shown in FIG. 14 of Sakai and FIG. 19 of Inao. (Sakai col. 2:42-46 and 64-67; Inao ¶¶ 11 and 14). In FIG. 2, Sakai and Inao plot their target currents, which have no sharp changes, through each phase of the motor. (Sakai col. 8:5-6; Inao ¶ 54). To achieve these

target currents, Sakai and Inao each teach a method and a circuit for sinking and sourcing current through the phases. (Sakai col. 8:5-29; Inao ¶¶ 54-55). For instance, to maintain a constant current in phase U while slowly increasing current in phase V and slowly decreasing current in phase W, upper transistor 1 is held ON, while lower transistors 4 and 6 are switched ON and OFF. (Sakai col. 8:16-29; Inao ¶ 55).

Nowhere does Sakai or Inao teach or suggest a method or circuit for preventing reverse current from entering into the power supply during a change of commutation state as required by the claimed invention. The Office Action suggests that logic control circuit 40 of Sakai and Inao functions to prevent reverse current. This element, however, does not prevent reverse current during a change of commutation state. Rather, logic control circuit 40 generates signals F1 and F2 provided to phase switch circuit 23 to control the switching of the two transistors that are switched while the third is held ON. (Sakai col. 9:42 - col. 11:38; Inao ¶¶ 63-75). For instance, in the above example, while upper transistor 1 is held ON, signals F1 and F2 provide the control for switching lower transistors 4 and 6. *Id.*

Nowhere is it taught that logic control circuit 40 prevents reverse current from entering the power supply upon change of commutation state. In fact, as shown in FIGS. 8 and 9 of Sakai and FIGS. 8-10 of Inao, these references teach that reverse current will enter the power supply. FIG. 8 of Sakai shows a regenerative coil current from the V-phase current I2 flows through diode 3D into the source. (Sakai col. 10:36-42). Likewise, FIG. 9 of Sakai shows regenerative coil currents from both the V- and W-phase currents I2 and I3. (Sakai col. 11:28-32). FIGS. 8-10 of Inao similarly teach reverse regenerative currents entering the power supply. Because the prior art of record does not teach or suggest a method or a circuit for preventing reverse current from entering into the power supply during a change of commutation state as required by claims 1-17, these claims are patentable over the prior art of record.

Claims 18-20 were canceled with this Amendment. Accordingly, their rejection is now moot and is not addressed herein.

New Claims 21-24

Independent claim 21 and its dependent claims 22-24 are each directed toward a motor controller for an electric motor having a plurality of motor terminals. The motor controller includes a plurality of motor drivers connected to the motor terminals. Sequencer logic commutes the motor by providing control signals to the motor drivers to drive a first of the motor terminals to a high voltage, drive a second of the motor terminals to an intermediate voltage, and alternately drive a third of the motor terminals between the high voltage and a low voltage. The motor controller further includes a reverse current control for driving the third motor terminal to the low voltage upon the occurrence of a high side commutation. As described above with reference to claims 1-17, none of the prior art of record teaches this claimed reverse current control for a motor controller. Accordingly, claims 21-24 are patentable over the prior art of record, and notice to that effect is respectfully requested.

Drawings

Submitted herewith is a replacement drawing sheet with a correction to FIG. 4. As described in the specification, "motor current I will flow from power supply terminal GND through diode D4, through coils L_V and L_W, through MOSFET M2 and continue to re-circulate until motor current I has discharged." (Page 10, line 26 - page 11, line 1). Further, "normal motor current I_1 will charge from the power supply as a standard motor current." (Page 11, lines 3-4). As originally filed, FIG. 4 inadvertently indicated that motor current I flowed both through diode D1 and MOSFET M2, and that motor current I_1 flowed from power supply terminal GND through sense resistor R_S. With this Amendment, FIG. 4 has been corrected to delete the arrow indicating that motor current I flows through diode D1, and to reverse the arrow indicating the direction of the current through sense resistor R_S. These corrections do not add any new matter, but rather bring FIG. 4 in conformity with the written description.

Conclusion

The application containing pending claims 1-17 and 21-24 is in condition for allowance. Reconsideration and notice to that effect is respectfully requested. The Examiner is invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate allowance of the application.

Respectfully submitted,

KINNEY & LANGE, P.A.

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By: Dina M Khaled

Dina M. Khaled, Reg. No. 52,761
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

DMK:bmg